Claims

1. An omni-directional imaging assembly comprising a solid omni-directional lens said omni-directional lens comprising:

   (a) a vertical axis of symmetry;

   (b) an upper surface, at least part of which is capable of reflecting rays that arrive from the inner side of the omni-directional lens;

   (c) a transparent perimeter surface;

   (d) a lower convex surface, at least part of which is capable of reflecting rays that arrive from the direction of said perimeter surface;

   (e) a transparent circular surface maintained in said lower convex surface around said vertical axis of symmetry;

   Wherein light rays from a first 360 degrees, panoramic, scene are refracted by said transparent perimeter surface, are then reflected by said lower convex surface towards said upper surface, and then reflected by said upper surface towards said transparent circular surface, then refracted and exit said omni-directional lens.

2. An omni-directional imaging assembly according to claim 1, wherein at least a part of the upper surface of the omni-directional lens is coated with reflective material on its exterior side to enable

reflection of rays that arrive at said upper surface from the interior of said omni-directional lens.

3. An omni-directional imaging assembly according to claim 1, wherein at least a part of the lower convex surface of the omni-directional lens is coated with reflective material on its exterior side to enable reflection of rays that arrive at said part of said lower convex surface from the direction of the perimeter surface.

4. An omni-directional imaging assembly according to claim 1, wherein the upper surface and/or the lower convex surface of said omni-directional lens are designed to enable Total Internal Reflection of rays that arrive at said surfaces, without the use of a reflective coating.

5. An omni- directional imaging assembly according to claim 1, further comprising a second transparent circular area maintained in the upper surface of the omni-directional lens around the vertical axis of symmetry; said second transparent circular area enabling penetration of rays from a second scene, at least partially different than the first scene, into said omni-directional lens, wherein rays from said second scene travel through said omni-

directional lens, are refracted by the transparent circular surface in the lower surface, and exit said omni-directional lens.

6. An omni-directional imaging assembly according to claim 5, further comprising an optical structure located coaxially with the omni-directional lens and above the upper surface of said lens; said optical structure being designed to control and enhance optical qualities of the second scene, before rays originating in said second scene are refracted by the second transparent circular area.

7. An omni-directional imaging assembly according to claim 6, wherein the optical structure is designed to control the aperture of the second scene.

8. An omni-directional imaging assembly according to claim 6, wherein the optical structure comprises a plurality of optical elements.

9. An omni-directional imaging assembly according to claim 1, further comprising an image capture device, directed towards the transparent circular surface in the lower surface of the omni-directional lens and having its optical axis coinciding with the vertical axis of symmetry of said omni-directional lens.

10. An omni-directional imaging assembly according to claim 9, wherein the image capture device comprises a focusing lens.

11. An omni-directional imaging assembly according to claim 9, further comprising a connector located between the omni-directional lens and the image capture device, said connector having a first edge and a second edge, wherein optical transparency exists between said first edge and said second edge, allowing light penetrating said first edge to reach and exit through said second edge essentially without distortion.

12. An omni-directional imaging assembly according to claim 11, wherein the connector is cylindrical in shape.

13. An omni-directional imaging assembly according to claim 11, wherein the first edge of the connector is designed to be connected to the omni-directional lens.

14. An omni-directional imaging assembly according to claim 11, wherein the second edge of the connector is designed to be connected to the image capture device.

15. An omni-directional imaging assembly according to claim 11, wherein the distance between the first edge of the connector and the second edge is designed to allow optimal focus by the image capture device of the image that arrives from the direction of the omni-directional lens.

16. An omni-directional imaging assembly according to claim 11, wherein the connector is fabricated together with, and as a part of, the omni-directional lens as a unified optical block.

17. An omni-directional imaging assembly according to claim 11, wherein the side edges of the connector have a transparent volume allowing rays that arrive from the second edge to travel through said side edges, to exit through the first edge, and to enter the omni-directional lens.

18. An omni-directional imaging assembly according to claim 17, further comprising an illumination source located adjacent to the second edge of the connector, said illumination source transmitting illumination towards the transparent volume of said connector; wherein illumination rays travel through said transparent volume of said connector, penetrate the omni-directional lens, and are distributed omni-directionally by the .

reflective and refractive surfaces of said omni-directional lens, thereby providing omni-directional illumination.

19. An omni-directional imaging assembly according to claim 11, wherein the outer surface of the side of the connector is blackened by a coating or by the presence of a mechanical element, thereby absorbing light and preventing glare.

20. An omni-directional imaging assembly according to claim 4, further comprising an illumination source located adjacent to the transparent area in the lower convex surface, said illumination source distributing illumination towards the interior of the omni-directional lens, which refracts and reflects said illumination rays distributing them omni-directionally, thereby providing omni-directional illumination.

21. An omni-directional imaging assembly according to claims 18 and 20, wherein the illumination source comprises a plurality of illumination sources.

22. An omni-directional imaging assembly according to claim 21, wherein the illumination source is capable of illumination at several different wavelengths.

23. An omni-directional imaging assembly according to claim 18 and 20, wherein the fabrication material and coating material of the omni-directional lens are suitable to distribute the spectral range of the illumination.

24. An omni-directional imaging assembly according to claim 1, wherein the upper surface of the omni-directional lens can be described by more than one geometrical curve.

25. An omni-directional imaging assembly according to claim 1, wherein the lower convex surface of the omni-directional lens can be described by more that one geometrical curve.

26. An omni-directional imaging assembly according to claim 5, further comprising a hole extending from the upper surface of the omni-directional lens to the lower convex surface around the vertical axis of symmetry, wherein said hole is designed such that rays from the second scene travel through said hole to pass through said omni-directional lens.

27. An omni-directional imaging assembly according to claim 26, further comprising an optical element placed within the hole,

wherein said optical element is designed to control the quality of the image of the second scene.

28. An omni-directional imaging assembly according to claim 27, wherein the outside surface of the optical element that is placed in the hole is coated with black coating to absorb light and prevent glare.

29. An omni-directional imaging assembly according to claim 26, wherein the surface of the hole is coated with black coating to absorb light and prevent glare.

30. An omni-directional imaging assembly according to claim 26, wherein the hole is cylindrical in shape.

31. An omni-directional imaging assembly according to claim 26, wherein the hole is conical in shape.

32. An omni-directional imaging assembly according to claim 1, further comprising cylindrical slots in the body of the omni-directional lens around the axis of symmetry, said slots formed in size and angle such as to not interfere with the optical path of rays

originating in scenes that should be covered by said omni-directional lens; wherein said slots absorb light and prevent glare.

33. An omni-directional imaging assembly according to claim 1, further comprising a prism and an illumination source; wherein said prism is located coaxially with the omni-directional lens and said illumination source is located to the side of said prism and directed towards said prism; wherein said prism is designed and positioned such as to transmit rays that arrive from the direction of said omni-directional lens to the desired location and to refract illumination rays originating at said illumination source towards said omni-directional lens.

34. An omni-directional imaging assembly according to claim 9, further comprising an image capture device located above and adjacent to said upper surface, directed opposite to the omni-directional lens, said image capture device being designed to cover an additional scene, at least partially different from the first scene.

35. An omni-directional imaging assembly according to claim 1, wherein the omni-directional lens further comprises a hole to the side of the vertical axis of symmetry, said hole extending from the

upper surface to the lower surface of said lens; wherein said hole comprises a mechanical channel.

36. An omni-directional imaging assembly according to claim 35, wherein the mechanical channel is used to pass gases, liquids, or mechanical devices through said mechanical channel for cleaning the exterior of the omni-directional lens.

37. An omni-directional imaging assembly according to claim 35, wherein the mechanical channel is used to pass surgical instruments through the omni-directional lens.